Docket No.: 65856-0025
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Scott A. Sirrine

Application No.: 09/736,232 — Confirmation No.: 9140

Filed: December 14, 2000 — Art Unit: 2128

For: DRIVELINE ANGLE ANALYZER — Examiner: H. D. Day

REPLY BRIEF in accordance with 37 C.F.R. 41.41

MS Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

This brief is responsive to the Examiner's Answer mailed on January 24, 2008; the Examiner's Advisory Action mailed June 5, 2007 (hereinafter "Advisory Action"); the Examiner's Final Rejection mailed March 16, 2007 (hereinafter the "Final Office Action") of claims 1-7 and 9-17 in the above-identified application; and the Notice of Panel Decision from Pre-Appeal Brief Review mailed on August 30, 2007. A Notice of Appeal was timely filed on July 16, 2007.

In addition to the remarks included in the Appeal Brief of October 30, 2007, please consider the following remarks in response to the Examiner's Answer of January 24, 2008.

REMARKS

The Examiner has rejected the pending claims under 37 C.F.R. 103 (a) over Eaton in view of Creger. In articulating the rejection, the Examiner states:

> It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the teachings of Eaton to incorporate the teachings of Creger to obtain the invention as specified in claim 1 **because torque (driveline inertia) is proportional to** the already determined **acceleration** (i.e., after acceleration has been determined by the Eaton DAA program the torque (driveline inertia) can be determined by multiplying I_{MN} and the determined acceleration, where I_{MN} is a calculated constant based on predetermined constants as taught by Creger

Examiner's Answer, mailed January 24, 2008, Page 6, lines 1-7, (**emphasis added**)

Accordingly, the Examiner's rejection depends upon whether torque is proportional to the acceleration of Creger. To be clear, torque is not driveline inertia, and torque is not proportional to the acceleration calculated by Eaton, as discussed in greater detail herein.

A. Terms that include the word "Inertia"

The Examiner has asserted in the "summary of the claimed subject matter" that inertia has been redefined and that (II) inertia as redefined is equivalent to torque (Examiner's Answer, mailed January 24, 2008, Page 2, line 18, and page 3, lines 18-19). Importantly, **inertia** (with no prefix or modifier) **has not been redefined** in either the specification or the claims. In the specification, the Appellant has used terms that include the word "inertia." These terms are not equivalent to inertia, but are based on the inertia of components of a driveline, as detailed in Subsections D and E below. These terms: "driveline inertia," "inertia of the vehicle driveline," "coast inertia" and "drive inertia" are clearly defined in the specification (paragraphs [0004], [0052] and [0053]) and distinguished from the term "inertia" with no prefix or modifier. Further, these terms are not equivalent to torque, as also detailed in Subsections D and E.

B. The Torsional Acceleration of Appellant's Equation 4 (and Eaton) is not related to the Acceleration of Creger, Equation 9

Paragraphs [0002] and [0003] of Appellant's specification clearly demonstrate an example of torsional acceleration of components of an articulated driveline that includes at least one universal joint (U-joint) (as shown, for example, in FIG. 6). In this example, a portion of a driveline is illustrated in FIGS. 1a and 1b where a drive side component is rotating in coaxial alignment with a driven side component. When the two components are coaxial, the rotational speed of the drive side component is identical to the rotational speed of the driven side component. Additionally, for a driveline such as shown in the illustrative embodiment of FIG. 6 with multiple drive shafts and yokes, if all rotating portions of the driveline are in coaxial alignment, then all rotating portions of the driveline are rotating at the same rotational speed.

FIG Ia

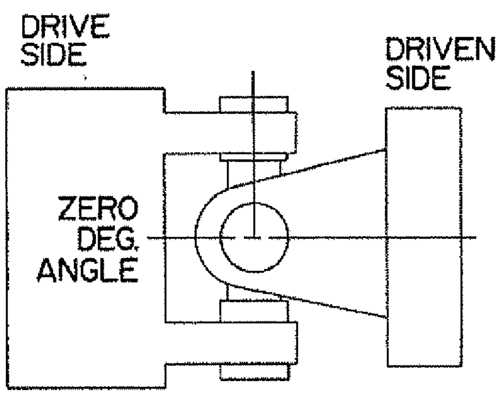


FIG Ib

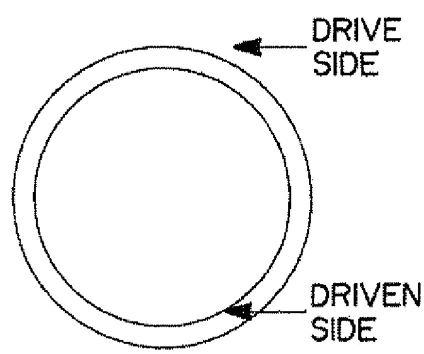


FIG - 6

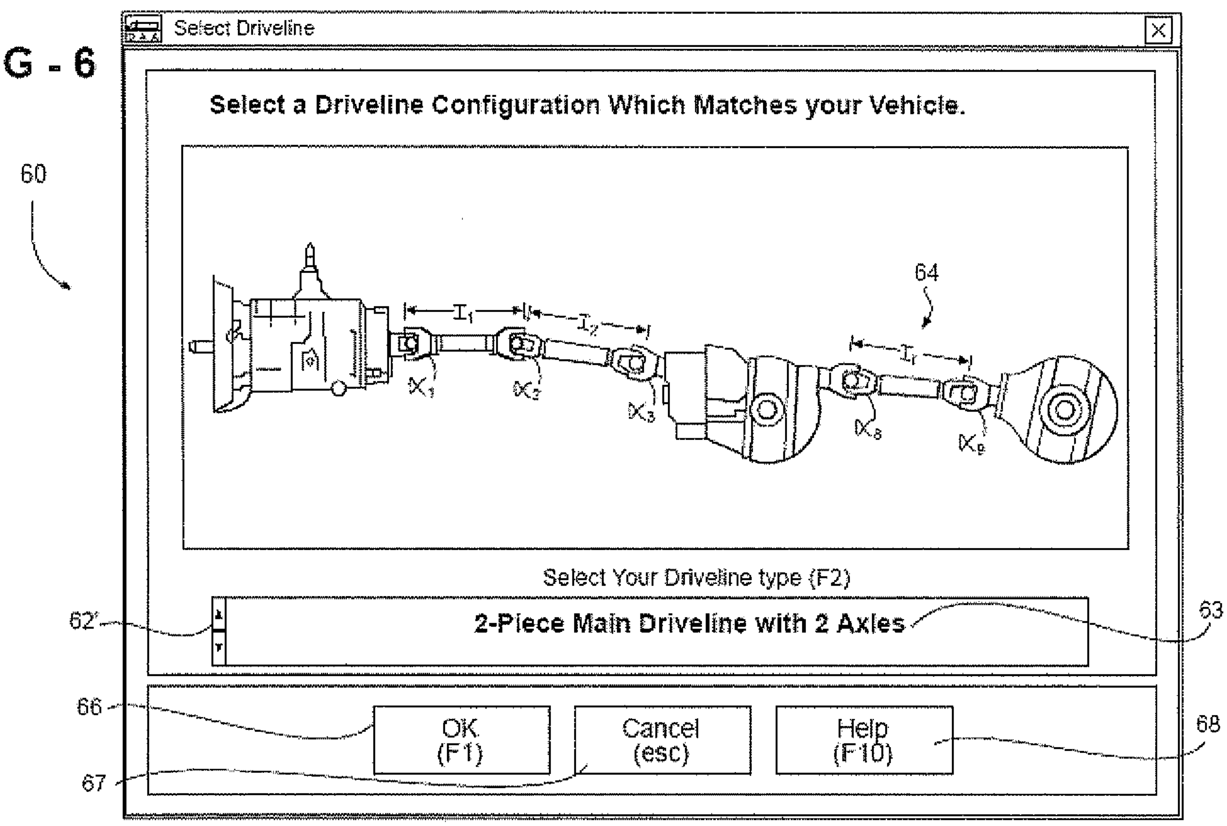
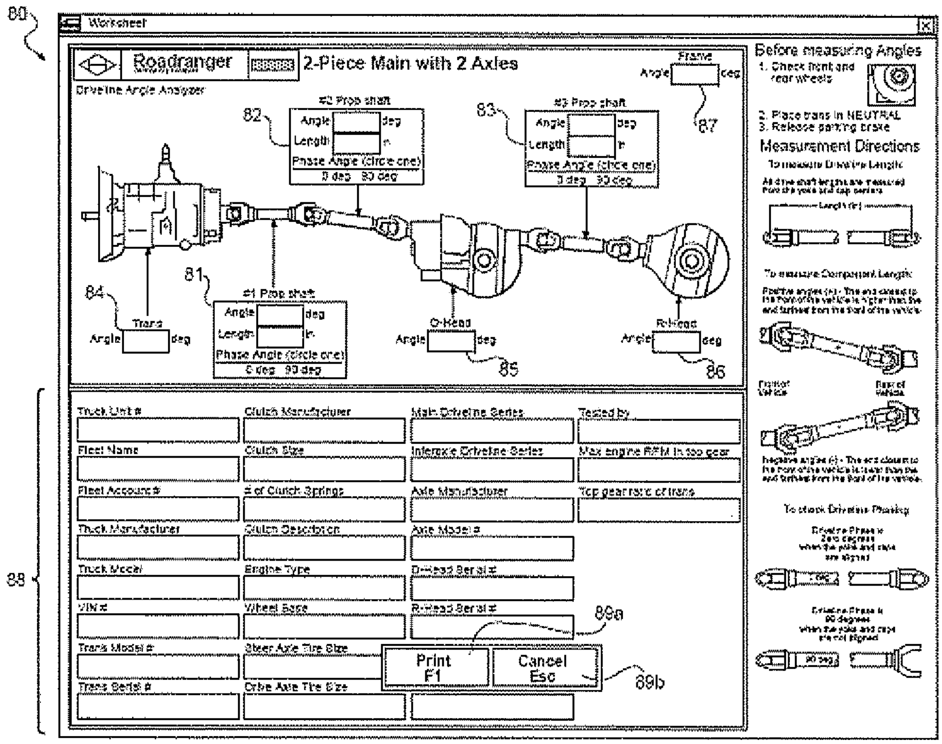

60
Select Driveline
Select a Driveline Configuration Which Matches your Vehicle.
64
Select Your Driveline type (F2)
62'
2-Piece Main Driveline with 2 Axles
63
66
OK
(F1)
Cancel
(esc)
Help
(F10)
68
67

FIG - 8



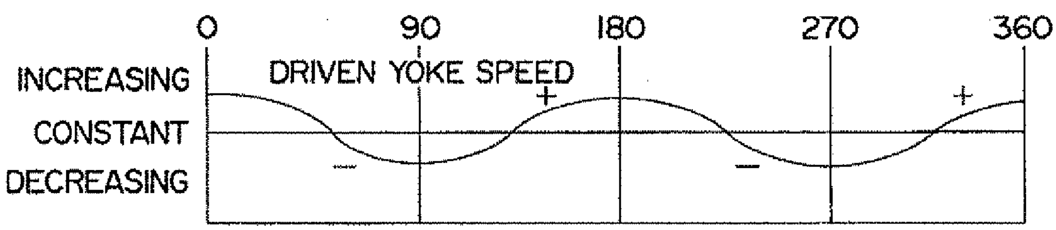


FIG 3

However (and as clearly described in paragraph [0003] and illustrated in FIGS. 2a and 2b of Appellant's specification), when the two components are **not** coaxial, the rotational speed of the drive side component is **not** identical to the rotational speed of the driven side component. (See Appellant's FIG. 3, reproduced above). That is, when the drive side component is rotating at a constant speed, the central gimbal portion connection of the U-joint

causes the rotational speed of the driven side component to oscillate[1], as clearly illustrated in the example of Appellant's FIG. 3[2]. This oscillatory speed of the driven side component produces a torsional acceleration (and torsional deceleration) of the driven side component as the drive side component is rotating at a constant rotational speed[3]. Generally, when viewing FIG. 6, the angles α_8 and α_9 indicate exemplary locations of the universal joint connections that may not be coaxial[4]. This non-coaxial configuration between adjacent components may be referred to as driveline angularity or driveline non-zero angularity.

The Eaton reference "is used to determine the u-joint acceleration (as a result of driveline angularity)." (Eaton, page 1, line 9). In contrast, the acceleration of the driveline mentioned in Creger is "the rotational acceleration of the engine output shaft," (Creger, column 5, line 64) which exists when the rotational speed of the entire driveline increases or decreases regardless of driveline angularity. The Examiner has confused the acceleration due to an increase or decrease in the engine rotational speed (transmitted through the driveline as mentioned in Creger, Equation 9) with the torsional acceleration that is solely the result of driveline angularity (as calculated in Appellant's Equation 4 and mentioned in Eaton, page 1, line 9). (*See specifically*, Examiner's Answer mailed January 24, 2008, page 17, lines 1-28).

Equation 4 (found in Appellant's specification, paragraph [0053] and reproduced below) clearly illustrates that the torsional acceleration θ (resulting from driveline angularity) is dependent upon the average rotational speed of the component (RPM) and an angle of the component α (or the angularity of the component). Since this torsional acceleration is a value of a first component relative to a second component (possibly a second component that is rotating

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[1] Although the average rotational speed of the driven side component is equal to the constant rotational speed of the drive side component.

[2] See also U. S. Patent 4,165,793, FIG. 2 and column 3, lines 61-65, illustrating that one of skill in the art would understand the oscillatory speeds resulting from a universal joint rotating at angle.

[3] In contrast, for the example of FIGS. 1a and 1b, with the drive side component rotating at a constant speed there is no torsional acceleration of the driven side component due to driveline angularity since both components are rotating at the same speed.

[4] Referring to FIGS. 6 and 8, when the axis of the yoke of the D-Head and the axis of the yoke of the R Head are parallel and not coaxial, the rotational speed of yoke of the D-Head is identical to the rotational speed of the yoke of the R Head. (As described in the last sentence of Appellant's paragraph [0003])

at a constant speed), the angle (α_8, see FIG. 6) is a measurement taken at the U-joint between the first component and the second component.

$$\theta_I = \left(\frac{RPM^2}{299356}\right)\alpha_8^2 \qquad \text{Equation 4}$$

This torsional acceleration value calculation of Appellant's Equation 4 produces a value that is indicative of the change in rotational speed oscillations (as shown in Appellant's FIG. 3) as an individual component of the vehicle driveline is "sped up" and "slowed down" relative to an adjacent component. The faster the average rotational speed of the driveline, the greater the frequency of the oscillations and therefore, the greater the magnitude (or severity) of the torsional acceleration for the chosen angle[5]. Importantly, this torsional acceleration value is in no way related to the acceleration of an engine (calculated in Creger, Equation 9) transmitted through the driveline.

In contrast, to determine the acceleration of a driveline component due to the engine shaft acceleration (as in Creger), one must know more than the rotational speed and the angle of the component relative to a reference. Accordingly, the torsional acceleration calculated in Appellant's Equation 4 cannot be the acceleration mentioned in Creger.

C. Calculated Inertia of the Vehicle Driveline

The torsional acceleration that is the result of driveline angularity generates the drive inertia and the coast inertia of the vehicle driveline.

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[5] Stated in other terms, the magnitude of the angle α is a measure of the amplitude of the speed variation of the component (illustrated in Appellant's FIG. 3) and the average rotational speed of the component (RPM) is a measure of how many times the rotational speed of the component increases and decreases per unit time. Thus, it follows that the greater the angle α, the greater the variation of the maximum speed and the minimum speed from the average speed of the component. Further, the greater the average rotational speed of the component (RPM), the greater the number of oscillations per unit time, and, accordingly, the greater the number of times that the component will experience a maximum speed and a minimum speed.

Paragraphs [0003] to [0005] of Appellant's specification are reproduced below.

> [0003] By way of background, a driveline angle (also known as the working angle) refers to the difference of the component angles on the drive side and driven side of a U-joint. All angle measurements are taken with zero degrees being parallel to the ground. As shown in Figs. 1a and 1b, each component on either side of the U-joint will rotate at the same rotational speed when the difference of the component angles on the drive side and driven side of the U-joint is zero. As shown in Figs. 2a and 2b, if the difference of the component angles is not zero, then the U-joint will cause the component on the driven side of the U-joint to rotate at a changing rate when the U-joint is rotated.
>
> [0004] As shown in Fig. 3, the speed of the component on the driven side of the U-joint will increase and decrease twice each 360 degree rotation. The constantly changing acceleration is commonly known as torsional acceleration and is measured in radians per second squared (rad/sec*2), where 1 radian is equal to 57 degrees. Torsional accelerations caused by the effect of U-joints are referred to as 2nd order torsionals (twice per rotation of the driveshaft). The effect of U-joint torsional acceleration can be cancelled for each driveshaft by ensuring that the working angles of the U-joints at each end of the driveshaft both have the same working angle.
>
> [0005] In addition to torsional acceleration, an inertial component is generated and is commonly known as driveline inertia, which is measured in foot pounds (ft-lbs). Typically, there are two overall system inertia values, drive and coast. Drive inertia occurs when power is being supplied by the engine through the transmission to the drive train. Coast inertia occurs when the vehicle is coasting and power is being supplied by the inertia of the vehicle and passing back through the axles to the rest of the drive train. **Unlike U-joint torsional acceleration, the effect of driveline inertia cannot be cancelled by ensuring that the working angles of the U-joints at each end of the driveshaft both have the same working angle**. However, the driveline inertia can be reduced by reducing component working angles and/or by using lower inertia driveline components
>
> **(emphasis added)**

The torsional acceleration that is the result of driveline angularity (of Appellant's specification and Eaton) is the cause of the "inertia of the vehicle driveline." Importantly, the inertia of the vehicle driveline, as positively recited in Claims 1, 7, and 12, is a value determined from the inertia of the individual component as the rotational speed of the individual component

increases and decreases due to the torsional acceleration that is the result of driveline angularity. That is, while the mass of an individual component within the driveline is accelerated and decelerated, the inertia of the individual component begets additional forces, such as side loadings on the bearings that restrain the individual component. To determine whether this "inertia of the vehicle driveline" is above an undesirable level, the inertia of the individual component is multiplied by a dimensionless factor that scales up (in this case, proportionally) with the magnitude of the torsional acceleration that is the result of driveline angularity. (See Equation 4 of Appellant's specification). That is, the magnitude of the "drive inertia" and "coast inertia" of an individual component is a factor of the inertia of the component and the "severity" of the rotational speed increases and decreases.

Accordingly, the acceleration of Creger (which is independent of the driveline angularity) cannot be used to determine the "inertia of the vehicle driveline" as positively recited in independent claims 1, 7, and 12.

D. "Drive Inertia" and "Coast Inertia" are not Torque

The Examiner has incorrectly concluded that since the calculation for "drive inertia" and "coast inertia" includes the rotational speed of the component, then the calculated value must be a torque. Specifically, the Examiner states:

> The claimed redefined term "inertia" has the meaning equivalent to the ordinary meaning of "torque" as used by one of ordinary skill in the relevant art.
>
> For example, as described in paragraph [0052], the inertias T_D and T_C as defined in equations (2) and (3) are functions of RPM. Therefore, when the driveline is at rest, (i.e., RPM = 0), the redefined inertias T_D and T_C are both equal to zero according to equations (2) and (3).
>
> Examiner's Answer, page 15, lines 10-11 and 14-16.

However, in order to determine the torque transferred through a component, one must know more than the rotational speed of the component (this is supported by Creger, generally at column 4, line 11 to column 5, line 50: and specifically at column 4, lines 35-36, column 5, lines

14-25 and equations 4-7; where at least the rotational speed *and* displacement of an engine are required to calculate torque). Accordingly, the Examiner's conclusion that the "drive inertia" and the "coast inertia" of equations 5 and 6 are equivalent to torque is incorrect.

E. Inertia of the Vehicle Driveline

As mentioned above, the "inertia of the vehicle driveline," (as positively recited in independent claims 1, 7, and 12) such as the "drive inertia" and the "coast inertia" is determined from the actual inertia of components of the driveline multiplied by a dimensionless factor that accounts for the severity of the effects of the driveline angularity. In the example of Appellant's Equations 5 and 6, the dimensionless factor is taken to be equivalent to the magnitude of the "torsional acceleration due to driveline angularity" since this magnitude is proportional to the severity of the effects that the rotational speed oscillations have on the mass of the individual driveline component. The values calculated in Equation 5 (drive inertia) and Equation 6 (coast inertia) of the Appellant's specification are <u>modified inertia values</u>. If the magnitude of angle α_8 and the magnitude of angle α_9 are equal, then the drive inertia is equal to the coast inertia for this component. As stated in Appellant's paragraphs [0004] and [0005] (reproduced above), the "effect of U-joint torsional acceleration can be cancelled for each driveshaft by ensuring that the working angles of the U-joints at each end of the driveshaft both have the same working angle," and "[u]nlike U-joint torsional acceleration, the effect of driveline inertia cannot be cancelled by ensuring that the working angles of the U-joints at each end of the driveshaft both have the same working angle."

Further, the Examiner has incorrectly concluded that the inertia of the vehicle driveline is equivalent to torque and that the Appellant has redefined "inertia." The Examiner states:

> In view of the specification, the term "inertia" as recited in the claims has been redefined and has a different meaning from its ordinary meaning by Appellant in paragraphs [0052] and [0053] of the specification. The claimed redefined term "inertia" has the meaning equivalent to the ordinary meaning of "torque" as used by one of ordinary skill in the art.

Examiner's Answer, page 15, lines 8-11.

Importantly, Appellant has been consistent in all remarks and the specification to distinguish between inertia (in general), "inertia of the driveline" "coast inertia" and "drive inertia." The Appellant has not intended to redefine any terms, but has introduced terms (that each include the word inertia) to describe the physical phenomena that exists in the exemplary drivelines of Appellant's specification. For purposes of clarity, inertia (in general) of an object is represented in Equations 5 and 6 as I_1, and is the inertia of the object, a value that has a magnitude when the object is not rotating and may be essentially the same as one of the "lumped inertia constants" of Creger. (*See* Appellant's specification, paragraph [0053], and Creger, Equation 9 and column 5, lines 55-65)

For further clarity, "inertia of the driveline" "coast inertia" and "drive inertia" are values that increase with the effect of the "torsional acceleration due to driveline angularity" as discussed herein. Accordingly, Equations 5 and 6 of appellant's specification calculate an "inertia of the driveline" (either "drive inertia" or "coast inertia" by multiplying the inertia (in general) of the component by a factor that is indicative of the severity of the torsional acceleration that the object is subjected to when another component is rotating at a constant rotational speed. As discussed above, in the example of Equations 5 and 6, the factor is equivalent to the "torsional acceleration due to driveline angularity."

In support of the Examiner's conclusions in the above cited passage, the Examiner notes that Equations 5 and 6 of Appellant's specification multiplies the inertia of a component by a factor to obtain either a "drive inertia" or a "coast inertia". Since this factor is proportional to torsional acceleration, the Examiner has looked to Equation 9 of Creger which states that (for the purposes of Creger) torque may be found by multiplying { I_{MN}, a value related to inertia] by {acceleration of an engine}. By equating (incorrectly) the acceleration of Creger with the "torsional acceleration" of Appellant's Equations 5 and 6, and equating the "inertia" of Creger with the individual inertia of a component of Appellant's specification, the Examiner has

concluded (again, incorrectly) that the "drive inertia" and the "coast inertia" of Appellant's Equations 5 and 6 is equivalent to the torque of Creger, Equation 9.

The Examiner has stated that "I_{MN} is a calculated constant based on predetermined constants as taught by Creger." (Examiner's Answer, mailed January 24, 2008, Page 6, lines 6-7). In contrast, and as detailed above, the "driveline inertia" positively recited in independent claims 1, 7, and 12 is variable (such as proportional to rotational speed as in the examples of Appellant's Equations 5 and 6).

F. "Based upon Entered Measurements"

Importantly, independent claims 1, 7, and 12 positively recite that this determination of the inertia of the vehicle driveline is made "based on the entered measurements" of the driveline configuration. Further, independent claim 7 includes the recitation "determining an inertia of the vehicle driveline based on the entered measurements of the driveline angles." In contrast, Creger merely calculates an inertia value based upon the inertia of the individual components of the driveline of Creger without including any values determined from measurements of the driveline configuration (such as driveline angles). (Creger, column 5, lines 62-63).

The Examiner has stated that "I_{MN} is a calculated constant based on predetermined constants as taught by Creger." (Examiner's Answer, mailed January 24, 2008, Page 6, lines 6-7). In contrast, and as detailed above, the "driveline inertia" positively recited in independent claims 1, 7, and 12 is variable (such as proportional to rotational speed) and based upon entered measurements.

CONCLUSION

In view of the foregoing argument, it is submitted that the final rejections of the pending claims are improper and should not be sustained. Therefore, a reversal of the final rejections of March 16, 2007 is respectfully requested.

Appellant believes that no fee is due with this Reply Brief. However, if a fee is due, please charge our Deposit Account No. 18-0013, under Order No. 65856-0025 from which the undersigned is authorized to draw. To the extent necessary, a petition for extension of time is hereby made, any fee for which should be charged to the above account.

Dated: March 24, 2008

Respectfully submitted,

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